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Small-scale clumps in the galactic halo and dark matter annihilation

Veniamin Berezinsky berezinsky@lngs.infn.it INFN, Laboratori Nazionali del Gran Sasso, I-67010 Assergi (AQ), Italy

Vyacheslav Dokuchaev dokuchaev@inr.npd.ac.ru Yury Eroshenko erosh@inr.npd.ac.ru Institute for Nuclear Research of the RAS, Moscow, Russia

abstract

Production of small-scale DM clumps is studied in the standard cosmological scenario with inflation-produced primeval fluctuation spectrum. A special attention is given to three following problems: (i) The mass spectrum of small-scale clumps with $M10^3M_\odot$ is calculated with tidal destruction of the clumps taken into account within the hierarchical model of clump structure. Only 0.1 - 0.5% of small clumps survive the stage of tidal destruction in each logarithmic mass interval $\Delta \ln M \sim 1$. (ii) The mass distribution of clumps has a cutoff at $M_{\rm min}$ due to diffusion of DM particles out of a fluctuation and free streaming at later stage. $M_{\rm min}$ is a model dependent quantity. In the case the neutralino, considered as a pure bino, is a DM particle, $M_{\rm min} \sim 10^{-8}M_\odot$. (iii) The evolution of density profile in a DM clump does not result in the singularity because of formation of the core under influence of tidal interaction. The radius of the core is $R_c \sim 0.1R$, where R is radius of the clump. The applications for annihilation of DM particles in the Galactic halo are studied. The number density of clumps as a function of their mass, radius and distance to the Galactic center is presented. The enhancement of annihilation signal due to clumpiness, valid for arbitrary DM particles, is calculated. In spite of small survival probability, the annihilation signal in most cases is dominated by clumps.